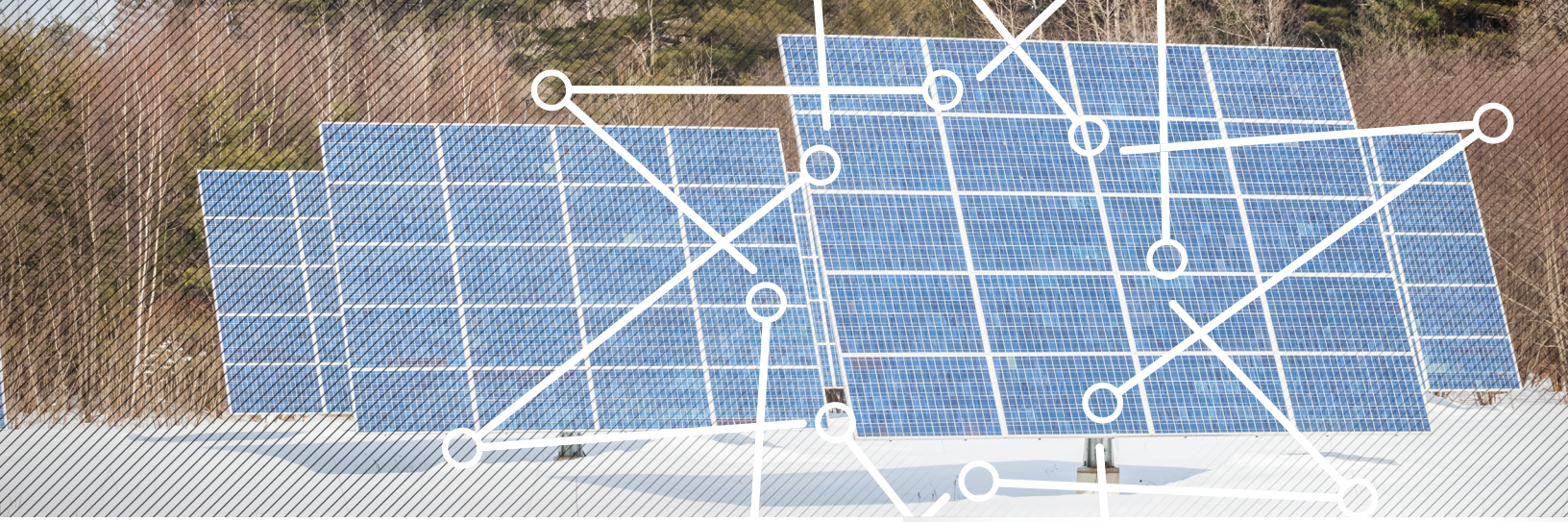

Severe Weather Considerations for Siting Solar PV Systems

Are the proposed roof and/or ground areas susceptible to heavy winds or snow loads?

- PV arrays can experience significant damage from strong winds generated by weather events such as thunderstorms, hurricanes, and derechos[1]. Often times these winds are unobstructed, meaning that they have a clear path towards a PV array. If a ground area is considered for PV siting, it is critical for there to be obstructions (e.g. buildings, trees, fences) to prevent or mitigate wind damage to a PV array. Consider installing a wind-calming fence.
- Turbulences patterns on roof equipment and over parapets create high pressure on specific zones of a roof-mounted PV array, and should be anticipated during the design phase. A structural engineer should specify the minimum number of roof attachments to prevent uplift on the PV arrays. It is recommended that all roof arrays include guidance from the Structural Engineering Association of California's (SEAOC) Wind Design for Solar Arrays report[2].
- Heavy wind loads can have a damaging effect on PV modules. If the proposed site experiences these conditions, consider specifying modules with minimum front and back pressure ratings (see Table 1).

Figure 1. Using SEAOC guidance can help design engineers adequately address wind loading for roof-mounted arrays.
Source: SEAOC

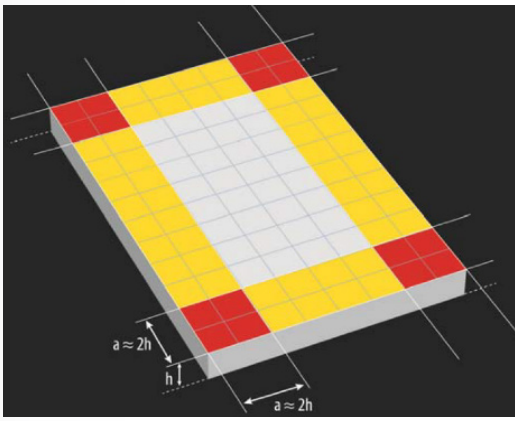

Table 1. Minimum Front and Back Pressure Ratings for PV Modules.

Module Side	Pascals (Pa)	Pounds per Square Foot (PSF)
Front Load (Push) Rating	*5400*	*113*
Back Load (Pull) Rating	*3600*	*75*

[1] https://rmi.org/insight/solar-under-storm/
[2] https://www.seaoc.org/news/374059/SEAOC-Wind-Design-for-Solar-Arrays-PV2-2017-is-now-available.htm

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Are the proposed roof and/or ground areas located in areas susceptible to snow loads?

- Snow adds heavy static loads to modules which may not be accounted for. This, in addition to wind during a winter storm, can add significant dynamic loads causing the racking assembly to severely deflect and even collapse. Engineers need to design for both static and dynamic loading.
- While high tilt angles can shed snow, the design engineer will have to balance the needs for snow shedding and reduce exposure to strong winds to determine the appropriate tilt angle of the array(s).

Does your site experience frequent or periodic hail storm events?

- Hail has been known to cause damage to solar PV systems. Utilize the Federal Emergency Management Agency's (FEMA) National Risk Index tool to confirm if your site experiences severe hail events.
- Consider specifying modules that have the FM Global 4478 certificate which includes a "Very Severe Hail Rating" for its module durability tests. Projects planners should also consider using modules that have undergone the Renewable Energy Test Center's (RETC) Hail Durability Test (HDT).
- Another effective measure is to consider installing tracker systems for ground mounted solar arrays that can shift their tilt angle to mitigate damage to the modules.[3]

Does your site experience extreme heat events?

- Locations that experience extreme heat events should carefully consider the location of PV equipment like inverters, transformers and switchgear. The performance of electrical equipment decreases with an increase in temperature. These components should never be located in direct sunlight as they may rapidly degrade under the harsh conditions.
- The overall performance of solar modules may decrease as temperature increases, therefore, it is recommended to invest in higher-end modules that come with a lower temperature coefficient and/or install vegetative covering like pollinator plants around the array areas.[4]

Is there old equipment (e.g. HVAC unit, communications tower) and/or nearby trees susceptible to falling or becoming wind borne debris located nearby a potential PV array location?

- If a site is considering roof areas for PV siting, it is important to mark any defunct and/or loose equipment to be removed or secured properly to avoid damaging the PV array in the event the equipment becomes airborne or falls.
- Trees can damage a PV array by falling onto it or striking it from the air when it becomes airborne from heavy winds. If a site is considering a ground area for PV siting, it is critical to identify the potential for trees to become a damaging element to a PV array.

Are the proposed ground array areas susceptible to soil erosion from stormwater runoff?

- Some sites face significant erosion from a lack of stormwater management which can undermine the foundations and structural integrity of a PV array. If a proposed area is experiencing soil erosion, it is recommended to consult with a civil engineer before marking these areas off for PV siting.
- Various storm water management measures like pollinator-friendly habitats and bioswales can be taken to reduce the area's erosion and make it viable for PV siting.[5]

Figure 2. Soil erosion can undermine the structural integrity of a PV array.
Source: Andy Walker, NREL

[3] https://www.solarpowerworldonline.com/2020/12/can-your-solar-project-weather-a-hailstorm/
[4] https://news.energysage.com/solar-panel-temperature-overheating/
[5] https://www.nrel.gov/solar/pv-smart.html

Are proposed ground array areas susceptible to flooding?

- A useful metric for this would be to confirm what the site's 500-year flood level is (i.e. using FEMA flood maps) and identify if the proposed areas for PV siting are located below that level.
- PV modules and electrical equipment such as inverters, batteries, and transformers may need to be installed at a higher elevation and/or on concrete pads above the site's 500-year flood level.
- Be aware of the elevation of the PV array(s) in relation to the Balance of System (BOS) equipment (e.g. inverters, switchgear). Underground conduit from the PV array(s) can become inundated with water and flood back to the BOS equipment if there is a significant elevation difference.

Is the project's structural engineer experienced with designing PV systems to compensate for current gaps in codes and standards?

- Experienced structural engineers understand that there are gaps in current codes and standards and know how to apply best practices from design guidance such as SEAOC.

Has the site's roof experienced any structural integrity issues that may overloaded from the additional weight of the PV array?

- If a roof is showing possible signs of structural integrity issues in the form of sagging, then the site should confirm if the additional weight load of a PV array will cause further sagging. Depressions in a roof are potential spots where rain from hurricanes can pool and cause the roof to sag. Look for signs of water ponding which may indicate a structural issue with the roof.
- Additionally, consider replacing the roof if the existing materials are showing signs of degradation as this may be a sign that your roof is susceptible to damage from prolonged severe weather.
- Has the roof membrane billowed up, separating from roof during wind event? If so, placing solar arrays on a membrane that could billow when air pressure in building is higher – this could cause array to be expelled from roof.

Does your site experience issues with corrosion due to close proximity to marine or coastal areas?

- In addition to heavy winds and flooding, hurricanes can cause damage to a PV array through salt-water which can cause corrosion to PV equipment like the racking assembly, electrical cabinets, and fasteners. Identifying existing equipment at a site that is experiencing corrosion may be helpful when siting PV as the site can specify what materials should be used in the PV system.

Figure 3. Corroded grounding lug.
Source: Gerald Robinson, LBNL

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